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Safety device for a vehicle

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The invention relates to a safety device for a vehicle, in particular for a motor vehicle, for reducing the risk of injury to a vehicle occupant in the event of lateral impact accidents, having at least one cushion element which is arranged on the vehicle laterally adjacent to an occupant position and can be moved by an actuating device from a rest position into a deployed position in the direction of the occupant position.

15 The invention also relates to a method for operating a safety device.

A safety device of said type is known from DE 28 56 437 C2. The actuating device comprises a lever, which is embodied in such a way that in the event of a lateral crash, the cushion element is moved by means of the lever in the direction of an occupant position more quickly than the structure of the passenger cell, on which the cushion element is arranged, moves in the direction of the occupant position on account of the accidental impact. An improvement in occupant protection in lateral impact accidents can be obtained with the arrangement proposed in DE 28 56 437 C2. It is however a problem that an occupant is not protected to an optimum degree in the event of a lateral impact even with this arrangement since, despite the relatively fast deploying movement of the cushion element, the distance between the cushion element and the occupant is too large, and therefore a relative movement between the cushion element and the occupant cannot be eliminated completely.

Proceeding from this, the invention is based on the object of producing a safety device for a vehicle, with which the risk of injury to a vehicle occupant in the event of lateral impact accidents can be reduced to a
5 minimum.

According to the invention, this object is achieved in that the actuating device can be driven by a vehicle-mounted drive. The cushion element can be moved with
10 the aid of the actuating device from a rest position into a deployed position in the direction of the occupant position by means of the vehicle-mounted drive, without external action, for example by means of an accidental impact, being necessary. Furthermore,
15 the cushion element can be actively moved in the direction of an occupant position in order to reduce the distance between an occupant and the impact-absorbing cushion element in the event of an impending or imminent accident. On account of the short distance
20 between the occupant and the cushion element, the occupant cannot reach any high speeds relative to the cushion element. Furthermore, the occupant can be cushioned by the cushion element, which is adjacent or at least situated in the direct vicinity, from the
25 start of the accident onward.

The activation of the actuating device by a vehicle-mounted drive does not exclude the possibility of the actuating device also being moved in the direction of
30 an occupant position by the action of a crash, as is already known from the prior art.

The cushion element can be arranged in or on a door or in or on a body pillar of the vehicle, so that the
35 pelvis and thorax of a vehicle occupant can be protected to an optimum degree.

A plurality of cushion elements and/or additional foam elements which are arranged in series are advantageously provided. The cushion elements and/or the foam elements can have a foam and/or honeycomb structure, so that they can absorb energy. The individual cushion elements and/or foam elements can also have a varied design. This makes progressive absorption of impact energy possible.

10 The cushion elements and/or foam elements can be arranged such that they can be displaced with respect to one another and/or can be at least indirectly guided by linear guides. These measures contribute to the cushion element or elements being moveable along a
15 defined movement path in the direction of an occupant position.

One particularly advantageous embodiment of the invention provides that the cushion element can be
20 locked in a deployed position. This has the advantage that the impact energy can be dissipated in the deployed state of the cushion element.

The vehicle-mounted drive is advantageously embodied as
25 an electric motor. This type of drive is comparatively cost-effective and can be powered by the electrical system of the vehicle at relatively low cost. The electric motor can drive the actuating device, which in turn moves the cushion element from a rest position
30 into a deployed position in the direction of the occupant position.

The actuating device can have a traction means which is embodied as a cable or belt and is advantageously
35 stored, at least in sections, in or on a store. The traction means can be wound in the store, it being possible for the store to be driven by the vehicle-

mounted drive. This measure permits an actuating device for moving the cushion element to be formed with a particularly compact and simple mechanism.

- 5 According to another embodiment, an auxiliary drive is provided for moving the cushion element in the direction of the occupant position. Said auxiliary drive can be formed by a spring store and/or by pyrotechnic elements. Said elements can be used to
10 bring about a further increase in movement speed relative to the actuation of the cushion element or elements activated by means of the vehicle-mounted drive.
- 15 It is very particularly advantageous if the vehicle-mounted drive and/or the auxiliary drive are/is coupled to sensors for detecting the vehicle state and/or the state of the vehicle's surroundings. This makes it possible to control the vehicle-mounted drive for the
20 actuating device in order to move the cushion element in the direction of the occupant position as early as before an impact against another party to an accident. Sensors for detecting the vehicle state can include wheel speed sensors or acceleration sensors, which are
25 also used for controlling other safety systems such as ABS, ESP or airbags. The surroundings of the vehicle can, for example, be monitored by means of cameras or other sensors which detect the surroundings (for example radar or infra-red sensors), so that another
30 party to an accident which is approaching the vehicle obstruction can be detected.

At least one return element for moving the at least one cushion element from a deployed position into the rest
35 position is advantageously provided. The system is therefore reversible and can be re-used. This is, for example, not possible in airbag systems, since they

must be replaced after they have been triggered. In contrast, the cushion elements of the safety device according to the invention can be returned to the rest position after having been preventatively deployed, if
5 no accident has occurred.

The return element is advantageously formed as a tension spring, so that the actuating device can move the cushion element from a rest position into a
10 deployed position counter to the action of the spring, and the cushion element can then be returned to its rest position by the action of the tension spring. The cushion element can also alternatively or optionally be reset by means of the actuating device which is driven
15 by the vehicle-mounted drive.

Further advantageous embodiments and details of the inventions will emerge from the following description, in which the invention is described and explained in
20 more detail on the basis of the exemplary embodiment illustrated in the drawing, in which:

Fig. 1 shows a side view of a section of a passenger cell having a safety device according to the
25 invention; and

Fig. 2 shows a cross-section through a safety device according to the invention corresponding to the section II-II in fig. 1.

30 Figure 1 illustrates a section of a passenger cell of a vehicle 2. The passenger cell has an A pillar 4 and a B pillar 6, a door 8 being arranged between the pillars. A safety device 10 and a safety device 12 are arranged on the door 8 in the region adjacent to the B
35 pillar 6. In addition, a further safety device 14 is provided in the B pillar 6, adjacent to the safety devices 10 and 12.

The safety device 10 is illustrated in cross section and in detail in figure 2. The door 8 has a door outer skin 16 which outwardly delimits the passenger cell of the vehicle 2. A foam element 18, which is stabilized by means of a schematically illustrated core 20, is provided adjacent to the door outer skin 16. The foam element serves to absorb impact energy in the event of a lateral impact against the door outer skin 16.

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An intermediate wall 22, which serves to reinforce the structure of the door 7, is provided adjacent to the foam element 18. A bearing plate 24 is arranged adjacent to the intermediate wall 22, on which bearing plate 24 are arranged a total of three foam elements, specifically an upper foam element 26, a central foam element 28 and a lower foam element 30. The foam elements 26 to 30 are of oblong form and extend in the direction of the interior space of the passenger cell of the vehicle 2. An upper cushion element 32 is displaceably mounted between the upper foam element 26 and the central foam element 28. In a corresponding fashion, a lower cushion element 34 is displaceably mounted between the central foam element 28 and the lower foam element 30. The cushion elements 32 and 34 are connected to a stowage compartment 36 whose interior space can be accessed by pivoting open an armrest 38.

The cushion elements 32 and 34 can be moved relative to the foam elements 26 to 30 by means of an actuating device which is denoted as a whole by the reference designation 40. The actuating device 40 comprises a tension belt 42, which is partially wound on a store 44. The actuating device 40 also comprises a drive 46 which drives the store 44, so that the tension belt 42 can be wound on to or unwound from the store 44. After

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exiting the store 44, the tension belt 42 is guided over a deflecting roller 48 and is initially wrapped around the lower foam element 30. The tension belt 42 then subsequently runs around the lower cushion element 34 and, as it runs on, around the central foam element 28, around the upper cushion element 32 and finally around the upper foam element 26. The tension belt 42 is secured at a fastening point 50 on the bearing plate 24.

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In order to permit a deploying movement, indicated by dashed arrows 52, of the cushion elements 32 and 34 and of the stowage compartment 36, the store 44 can be driven in the drive direction denoted by 54 by means of the drive 46. This causes the tension belt to be moved in the direction denoted by 56 and to be wound onto the store 44. As the tension belt 42 is wound, the section of the tension band between the store 44 and the fastening point 50 is shortened, so that the cushion elements 32 and 34 together with the stowage compartment 36 perform a deploying movement indicated by the arrows 52. It is possible to form the store 44 as an automatic roll-up device which makes it possible to lock the tension belt 42 in a certain position. If this locking is carried out in a deployed position of the cushion elements 32 and 34, said cushion elements 32 and 34 can be locked in the deployed position.

The cushion elements 32 and 34 and the stowage compartment 36 can be moved back from a deployed position into a rest position, illustrated in figure 2, by means of two tension springs 58 which are arranged on the bearing plate 24 and are connected to the cushion elements 32 and 34. Here, the stowage compartment 36 is guided by means of a linear guide 60.

With the presented safety device, it is possible for the cushion elements 32 and 34 and the stowage compartment 36 to be moved from the rest position illustrated in figure 2 into a deployed position as early as before an impact of another party to an accident against the door skin 16, so that the distance between a vehicle occupant and the stowage compartment 36 can be reduced to a minimum as early as before the start of the accident. This makes optimum occupant protection possible.